

[54] **APPARATUS AND PROCESS FOR MEASURING FIBER LENGTHS**

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[58] Field of Search **356/199, 167, 242, 356/239, 238; 250/219 S; 73/159**

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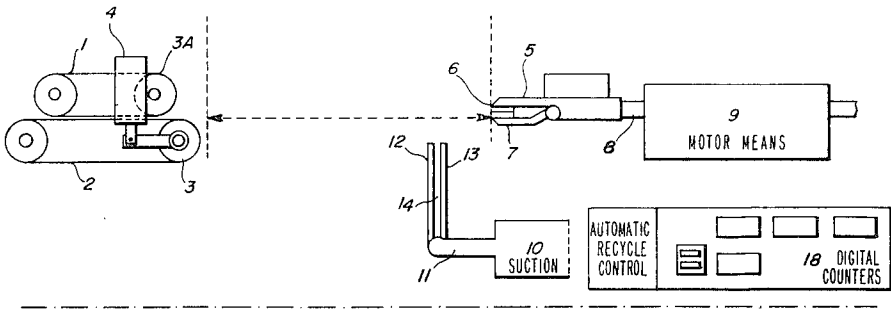
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[57] **ABSTRACT**

An apparatus and process are disclosed and claimed for measuring fiber lengths which involves the use of gripping means to hold the fibers together, a suction means for straightening the fibers between two substantially parallel transparent plates and counting means comprising at least one photocell mounted on a carriage with at least one fiber optic duct terminating in juxtaposition therewith.

6 Claims, 3 Drawing Figures



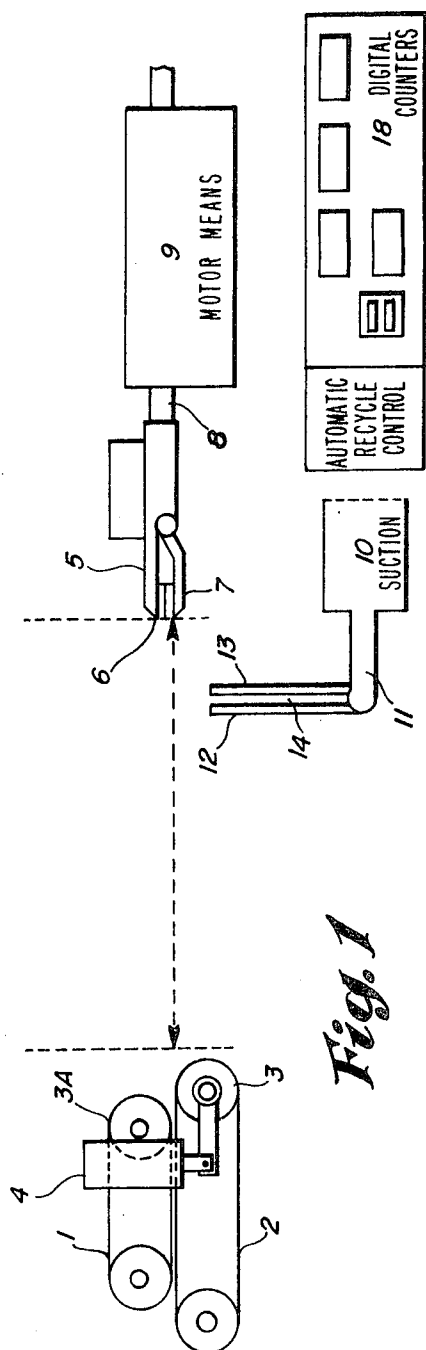


Fig. 1

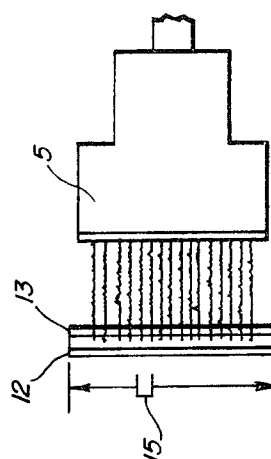


Fig. 2

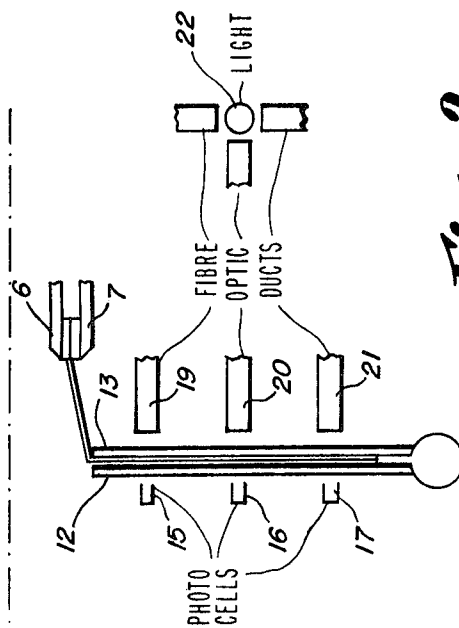


Fig. 3

APPARATUS AND PROCESS FOR MEASURING FIBER LENGTHS

This invention relates to measuring and assessing lengths of fibers in a substantially twist-free and parallel assembly such as a sliver, roving or top.

Both natural and synthetic fibers normally have a distribution of fiber lengths rather than one unique length. It is useful to know both the average fiber length and the distribution of lengths, and heretofore these have had to be measured by painstaking manual means. An electronic device is described for wool fibers in U.S. Pat No. 3,237,098 which comprises capacitance measurements.

According to this invention we provide an apparatus for measuring fiber lengths in a longitudinally oriented fiber assembly such as a sliver, roving or top, comprising means for gripping such assembly at a predetermined distance from its leading end, withdrawing gripped fibers from the assembly, pneumatic means for straightening the gripped fibers and means for counting the number of gripped and straightened fibers at one or predetermined distances from such gripping means. We also provide means for intermittently forwarding and ribboning such assembly to the means for gripping such assembly at a predetermined distance from its leading end and means for withdrawing such gripping means away from such forwarding means.

We prefer that such straightening means comprise a stream of air, but other fluids can be used, provided they do not destroy the fibers or the exposed surfaces of the apparatus. The straightening means may be adapted to remove the gripped fibers from the gripping means on release of the grip, after counting. This may be done by suitable ducting through which the released fibers are sucked or blown to a collecting box or container.

In a preferred form of the apparatus of this invention means are provided to repeat the cycle of forwarding, gripping, withdrawing, straightening, counting and removing actions, automatically in programmed predetermined sequence and timing. This may be done by suitable cams operating valves of pneumatic pistons for reciprocating the gripping means as well as opening and closing jaws on the gripping means.

We also provide a method of measuring fiber lengths in a substantially parallel assembly of fibers such as a sliver, roving or top, comprising intermittently forwarding such assembly to a first predetermined position, gripping leading end-portions of fibers projecting from the assembly, withdrawing these gripped projecting fibers from the assembly away from the first to a second predetermined position, straightening the gripped fibers and counting the gripped fibers at one or at a plurality of predetermined distances from the gripped end-portions.

It will be appreciated that the predetermined distances at which the gripped fibers are counted must be less than the distance between the first and second position.

The projecting fibers should be gripped by the moveable gripping means at a distance from the projecting fiber tips which conveniently is less than 10 percent and preferably less than 5 percent of the average fiber length in the assembly. Normally the fibers should be gripped about 2 mm. preferably 1 mm. from the leading end of the fiber.

Man-made fibers are normally cut from continuous filaments into predetermined nominal lengths. However, in practice some filaments may be cut at slightly greater or smaller intervals than the predetermined nominal value, and some filaments may also be cut at intervals which are a multiple of the predetermined value. Such multiple fiber lengths or overlength fibers may cause particular trouble during subsequent drafting and spinning into yarns on machines which are adapted to receive fibers of the nominal length. It is desirable therefore to detect the presence and measure the number of such over-length fibers, and the apparatus and process of this invention may be adapted either to measure a complete fiber length distribution or only to measure the proportion of overlength fibers.

In a preferred method which will be described in greater detail hereafter, the gripped fibers are drawn over and sucked into a gap or slit between two flat transparent plates, prior to and during the counting operation. Counting of fibers at different predetermined lengths from the gripping means is preferably effected by scanning photo-electric means operating in conjunction with appropriate light sources and recording the picked up impulses by a digital counter.

The pre-determined distances or lengths from the gripping means will depend on the nominal lengths of the fibers. The photo-electric means for scanning nearest to the gripping means will thus detect and the digital counter connected thereto, record the number of fibers which have actuated the photo-electric means and which fibers are of a length in excess of a nominal length. In this way overlength fibers can be detected.

We therefore also provide a preferred apparatus for assessing the number of over-length fibers in a feedstock such as a sliver, roving or top, comprising means for advancing the feedstock by fixed predetermined increment towards a gripping means, with means for reciprocating the gripping means to a fixed distance from the advancing means, means for gripping the fiber end-portions protruding from the feedstock, automatic means for returning the gripping means by the fixed distance, a pair of substantially parallel transparent, preferably glass, plates forming a gap or slit therebetween, means for applying suction below the slit so as to suck the free ends of the fibers held by the gripping means into said gap and straightening the fibers whilst being held by said gripping means, measuring means comprising one or more photo-electric measuring device means spaced at predetermined distances preferably in line with corresponding light sources in juxtapositions on either side of the transparent plates, means for scanning the fiber ends whilst so held and protruding into the gap between the transparent plates by traversing the photo-electric means across the gap formed by the transparent plates; means for automatically counting the fibers between said plates and means for recording the number of fibers detected by each photo-electric means conveniently by a digital counter connected to the photo-electric means.

Pressure between forwarding belts is adjusted so that the fiber assembly, sliver, roving or top is gently compressed into a ribbon of a width which is less than the width of the jaws of the gripping means and so that the thickness is less than the open jaws, in order to ensure that the gripping means can pull out any gripped fibers, substantially in side by side relationship and without breaking any fibers. We have found co-operating

aprons satisfactory when both aprons are driven at the same surface speed and if at least the last pair of rollers is not in nipping relationship. Preferably the axes of all rollers are parallel and the distance between one set of rollers which are driving the second apron or belt, substantially as shown in FIG. 1.

A fiber release agent may be applied to prevent fibers remaining stuck to the gripping means. French chalk may be used sparingly, care being taken that no deposits of release agent or extraneous dust remain on the measuring device for counting the fibers e.g. photocells and light ducting, which would affect the efficiency of the counter.

By careful preparation of the sample and selection of suitable dimensions of the fiber assembly, which is then presented in a substantially parallelized, longitudinally oriented array, gently compressed between the forwarding means to the gripping means, the cycle of operation can be speeded up. We have been able to operate at a speed of about 1 cycle per 7 second.

It should be appreciated that the term "straightening" of the fiber is used somewhat loosely and that the relative lengths of fibers may be effectively measured even if they retain some crimped configuration.

It should also be appreciated that the preparation and presentation of a representative sample of fibers is essential to obtain meaningful results. The width of the ribbon of fibers should therefore be less than the width of the gripping means or jaws and of course the open jaws should be capable of gripping fibers from the whole width and thickness of the parallelized or oriented ribbon of fibers. Clusters of fibers should also be eliminated e.g. by carding the sample before forming a sliver roving or top. This means that it should be possible for the gripping means to pull out the fibers from the ribbon when gripping them within about 1 mm. from their leading ends.

We have found two co-operating driven aprons or belts suitable, with rolls spaced so that the rolls are not in nipping relationship as shown in FIG. 1.

It may be desirable to assess the quantity of overlengths fibers not only in each scan but also in a quantity of unit weight of feedstock, this may be done by weighing the fibers. We provide a means of doing this, comprising suitable, preferably flexible, ducting which may be communicating with or be the same as ducting providing the suction means connected to the two flat transparent plates forming the gap or slit therebetween and terminating in a container in which the scanned fibers may be stored after release from the gripping means. After a predetermined number of scanning cycles and reciprocating movements of the gripping means, after each of which the fibers are released and are collected in the container, they may be weighed and their weight correlated to the number of overlength fibers detected by the photo-electric means and counted by the digital counter.

A preferred embodiment of our invention is described by reference to the attached drawing, in which:

FIG. 1 is a diagrammatic side view of the apparatus;

FIG. 2 is a diagrammatic partial plan view of the apparatus shown in FIG. 1, and

FIG. 3 is a slightly enlarged side view of a detail of the apparatus shown in FIG. 1.

Referring to FIG. 1, fiber feedstock in the form of a sliver containing crimped polyethylene terephthalate

fibers of nominal staple length $1\frac{1}{2}$ inches is fed forward between two feed aprons 1 and 2 at predetermined steps of 1 mm., by intermittently rotating driven rollers 3 and 3A at intervals actuated by solenoid drive 4.

The gripping means 5 comprising a rubber-lined fixed upper clamp 6 and co-operating rubber-lined bottom jaw 7 are fixed to a piston rod 8, actuated by a linear motor or pneumatic piston and cylinder 9 and advanced towards the feed aprons 1 and 2. The piston with the closed gripping means then retracts to a position as shown by dotted lines in FIG. 1.

Air suction is applied to container 10 or duct 11 which in turn is connected to the base of two parallel transparent (glass) plates 12 and 13 which form a gap or slit 14 into which the fibers held by the jaws 6 and 7 are deflected by air drag and substantially straightened (i.e. straightening their crimp) as shown in plan view in FIG. 2.

Photo-electric means operating in conjunction with appropriate light sources are mounted on a carriage for scanning. They comprise three photocells 15, 16 and 17 positioned near plate 12 and each photocell is illuminated by a single light source 22 via three fiber optic ducts 19, 20 and 21 terminating in juxtapositions near plate 13 on the other side of the gap between the plates.

The co-operating photocells and ducted light sources mounted on the carriage (not shown) are moved simultaneously to the far end of the glass plates. The individual fibers in the gap between the glass plates each cause an impulse as the photocells advance and the impulses are recorded by three digital counters 18.

After each traverse the gripping means open and the fibers are released. Due to the air drag they are conveyed into container 10 via duct 11.

The process is repeated a predetermined number of times. Each time the fibers are scanned by photocells 15, 16 and 17 with co-operating directed lights 19, 20 and 21 detecting any fibers which are longer than their fellows held by the clamp or gripping means.

Fibers released after scanning may be collected and weighed so that the counted fibers of any predetermined lengths may be correlated to the total quantity of fibers withdrawn by the apparatus from the assembly of fibers.

In one form of the apparatus, similar to the one illustrated in the drawings, the means for reciprocating the gripping means to a fixed distance from the advancing means, the fixed distance is about 6 inches and the distance between the gripping means and the path of the nearest photocell is adjusted to say $1\frac{1}{4}$ inches, when it is desired to monitor fibers of nominal length of $1\frac{1}{2}$ inches.

It will be appreciated that under these conditions fibers up to 6 inches will be satisfactorily detected and cleared after each cycle. However, in the rare and unlikely event that multi-length fibers are present which are longer than 6 inches, such fibers will remain dangling in the slit, moreover they cannot be gripped by the jaws as they remain clamped between the feed aprons and such multilength fibers will be counted until their whole length is discharged from the forwarding aprons, thus resulting in registering overlengths until the fault is detected visually. We therefore provide a method for detecting such multilength fibers comprising interposing a scouting traverse with the photocells in a non-phased timing cycle i.e. when the jaws of the

gripping means are open. If the photocells then detect a fiber because:

a. a multilength fiber remains clamped between the aprons, and or if

b. one or more fibers have remained stuck on the gripping means or between the plates, and or

c. if there is any extraneous matter e.g. on the photocells or the plates forming the gap, or the light ducting, which would result in registering overlengths, the pulse from the cells is used to give an alarm or to stop the apparatus, until the obstruction has been cleared. The trip mechanism can then be released and normal cycling resumed.

In addition or in the alternative a clearing device such as a knife may be used. This may be mounted on the traversing carriage, and designed to clear any fibers trapped between the aprons and the slit.

The count from each photocell is displayed on a counter. In the afore described apparatus there are three photocells positioned for scanning fiber lengths of e.g. 1¾ inches, 2½ inches and 3 inches, respectively i.e. one-fourth inch, 1 inch and 1½ inches above the nominal fiber lengths.

It will be appreciated that the two cells positioned nearer to the gripping means will also record the long fibers recorded by the third cell and that therefore the readings must be subtracted to obtain the correct number for each overlength position.

Sequence of preferred operating programme:

1. Sliver is advanced 1 mm. between aprons.
2. Clamp in open position is forwarded to aprons (6 inch stroke).
3. Clamp closes.
4. Clamp is withdrawn by 6 inch stroke and fibers drawn, by air stream into transparent slit, positioned below clamp.
5. Photoelectric cells scan fiber and the number of fibers detected by each cell is recorded on a digital cumulative counter.
6. Clamp opens and fibers are drawn into fiber container. The time taken for one complete cycle is 7 seconds.

What we claim is:

1. An apparatus for measuring fiber lengths in a longitudinally oriented fiber assembly, comprising fiber assembly advance means, fiber gripping and withdrawal means for gripping leading end-portions of fibers projecting from the fiber assembly advance means and withdrawing the gripped fibers from the advance means, suction means located in the path of said withdrawal means for engaging the free ends of fibers projecting from said fiber gripping means with suction action, said suction means having a longitudinal chamber for said fibers of substantially parallel light-transparent plates, and means for counting said fibers held by the gripping means in said chamber, said counting means sensing said fibers through said transparent chamber plates.

2. The apparatus of claim 1 wherein the means for counting said fibers is a photoelectric sensor coupled with a digital counter.

3. The apparatus of claim 2 wherein the photoelectric sensor is mounted for traverse along the transparent chamber plates.

4. The apparatus of claim 1 having means for automatic recycling the means for advancing, gripping, withdrawing, suction and counting said fibers.

5. A method for measuring fiber lengths in a substantially parallel assembly of staple fibers comprising forwarding said assembly of fibers a predetermined distance less than the length of said individual fibers, gripping said assembly of fibers and withdrawing fibers grasped away from said fiber assembly taking therewith the gripped fibers, passing said gripped fibers across a suction chamber having transparent sidewalls, drawing said fibers into the suction chamber to thereby straighten the fibers held within the suction chamber, photoelectrically sensing the straightened fibers through the sidewalls of said suction chamber and counting and measuring said gripped fibers in said suction chamber.

6. The method of claim 5 including the steps of releasing the gripped fibers on completion of the photoelectric sensing and repeating the cycle.

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